

WHAT IS CLAIMED IS:

1. An apparatus for processing a surface of a substrate, comprising:
  - a chamber that contains a gas atmosphere, the chamber including an inner wall;
  - a substrate holder within the chamber that holds the substrate;
  - a plasma source that generates a plasma by supplying first electromagnetic waves with a first electric power to the gas atmosphere;
  - a bias source that generates a bias voltage by supplying second electromagnetic waves with a second electric power to the substrate holder, charged species in the plasma being accelerated by the bias voltage and directed toward the surface of the substrate so that the surface is processed by the accelerated charged species; and
  - a controller that produces a control signal by monitoring the bias voltage and a ground current that flows from the plasma to the inner wall of the chamber, the control signal being used to control the first electric power.
2. The apparatus according to claim 1, wherein the inner wall is a ground electrode electrically isolated from a remaining portion of the chamber.
3. The apparatus according to claim 2, wherein the ground electrode is replaceable.
4. The apparatus according to claim 1, wherein the controller controls the first electric power and the second electric power using the control signal.
5. An apparatus for processing a surface of a substrate, comprising:
  - a chamber that contains a gas atmosphere, the chamber including an inner wall;
  - a substrate holder within the chamber that holds the substrate;
  - a plasma source that generates a plasma by supplying first electromagnetic waves with a first electric power to the gas atmosphere;
  - a bias source that generates a bias voltage by supplying second electromagnetic waves with a second electric power to the substrate holder, charged species in the plasma being accelerated by the bias voltage and directed toward the surface of the substrate so that the surface is processed by the accelerated charged species; and
  - a controller that controls the first electric power such that the bias voltage is maintained within a selected range by increasing the first electric power

when the bias voltage is higher than a selected upper limit and decreasing the first electric power when the bias voltage is lower than a selected lower limit.

6. An apparatus for processing a surface of a substrate, comprising:  
a chamber that contains a gas atmosphere, the chamber including an  
5 inner wall;  
a substrate holder within the chamber that holds the substrate;  
a plasma source that generates a plasma by supplying first  
electromagnetic waves with a first electric power to the gas atmosphere, the inner wall  
being situated such that reaction products deposit on the inner wall, the reaction  
10 products deposited on the inner wall having an influence on the plasma;  
a bias source that generates a bias voltage by supplying second  
electromagnetic waves with a second electric power to the substrate holder, charged  
species in the plasma being accelerated by the bias voltage and directed toward the  
surface of the substrate so that the surface is processed by the accelerated charged  
15 species; and  
a controller that controls the first electric power to compensate the  
influence of the reaction products deposited on the inner wall, wherein:  
the controller monitors an amount of the reaction products deposited  
on the inner wall by monitoring the bias voltage; and  
20 the controller decreases the first electric power when an increase in the  
amount of the reaction products is monitored and increases the first electric power  
when a decrease in the amount of the reaction products is monitored.
7. The apparatus according to claim 6, wherein the controller monitors  
the amount of the reaction products by monitoring the bias voltage and a ground  
25 current that flows from the plasma to the inner wall.
8. The apparatus according to claim 7, wherein the inner wall is a ground  
electrode electrically isolated from a remaining portion of the chamber.
9. An apparatus for processing a surface of a substrate, comprising:  
means for holding the substrate on a substrate holder in a chamber, the  
30 chamber including an inner wall;  
means for generating a plasma by supplying first electromagnetic  
waves with a first electric power to a gas atmosphere within the chamber;  
means for applying a bias voltage to the substrate by supplying second  
electromagnetic waves with a second electric power to the substrate holder so that the

surface of the substrate is processed by charged species in the plasma accelerated by the bias voltage;

means for monitoring the bias voltage and a ground current that flows from the plasma to the inner wall of the chamber to produce a control signal; and

5 means for controlling the first electric power using the control signal.

10. A method for processing a surface of a substrate, comprising:

holding the substrate on a substrate holder in a chamber, the chamber including an inner wall;

10 generating a plasma by supplying first electromagnetic waves with a first electric power to a gas atmosphere within the chamber;

applying a bias voltage to the substrate by supplying second electromagnetic waves with a second electric power to the substrate holder so that the surface of the substrate is processed by charged species in the plasma accelerated by the bias voltage;

15 monitoring the bias voltage and a ground current that flows from the plasma to the inner wall of the chamber to produce a control signal; and

controlling the first electric power using the control signal.

11. The method according to claim 10, wherein the controlling comprises controlling the first electric power and the second electric power using the control signal.

12. The method according to claim 10, wherein the inner wall is a ground electrode electrically isolated from a remaining portion of the chamber.

13. A method for processing a surface of a substrate, comprising:  
25 holding the substrate on a substrate holder in a chamber, the chamber including an inner wall;

generating a plasma by supplying first electromagnetic waves with a first electric power to a gas atmosphere within the chamber;

30 applying a bias voltage to the substrate by supplying second electromagnetic waves with a second electric power to the substrate holder so that the surface of the substrate is processed by charged species in the plasma accelerated by the bias voltage;

controlling the first electric power, including increasing the first electric power when the bias voltage is higher than a selected upper limit, and

decreasing the first electric power when the bias voltage is lower than a selected lower limit.

14. A method for processing a surface of a substrate, comprising:

  - holding the substrate on a substrate holder in a chamber, the chamber
  - including an inner wall;
  - generating a plasma by supplying first electromagnetic waves with a first electric power to a gas atmosphere within the chamber;
  - applying a bias voltage to the substrate by supplying second electromagnetic waves with a second electric power to the substrate holder so that the surface of the substrate is processed by charged species in the plasma accelerated by the bias voltage;
  - controlling the first electric power to maintain the bias voltage within a selected range; and
  - when the bias voltage is not maintained within the selected range,
  - controlling the second electric power to maintain the bias voltage within the selected range.
15. A method for processing a surface of a substrate, comprising:

  - holding the substrate on a substrate holder in a chamber, the chamber having an inner wall;
  - generating a plasma by supplying first electromagnetic waves with a first electric power to a gas atmosphere within the chamber;
  - applying a bias voltage to the substrate by supplying second electromagnetic waves with a second electric power to the substrate holder so that the surface of the substrate is processed by charged species in the plasma accelerated by the bias voltage;
  - controlling the first electric power and the second electric power, including:
    - a) monitoring the bias voltage and a ground current that flows from the plasma to the inner wall; and
    - b) when the bias voltage is outside of a first selected range and the ground current is outside of a second selected range, changing the first electric power.
16. The method according to claim 15, wherein the controlling further comprises changing the second electric power when the bias voltage is outside of the first selected range and the ground current is within the second selected range.

17. The method according to claim 15, wherein the inner wall of the chamber is a ground electrode electrically isolated from a remaining portion of the chamber.

18. A method for successively processing a plurality of substrates in a chamber, comprising:

holding one of the plurality of the substrates on a substrate holder within the chamber, the chamber including an inner wall;

generating a plasma by supplying first electromagnetic waves with a first electric power to a gas atmosphere within the chamber;

applying a bias voltage to the substrate by supplying second electromagnetic waves with a second electric power to the substrate holder so that the surface of the substrate is processed by charged species in the plasma accelerated by the bias voltage;

depositing reaction products on the inner wall of the chamber, the reaction products deposited on the inner wall having an influence on the plasma;

monitoring an amount of the reaction products deposited on the inner wall by monitoring the bias voltage; and

controlling the first electric power to compensate the influence of the reaction products, including decreasing the first electric power when an increase in the amount of the reaction products is monitored, and increasing the first electric power when a decrease in the amount of the reaction products is monitored.

19. The method according to claim 18, wherein the monitoring monitors the amount of the reaction products by monitoring the bias voltage and a ground current that flows from the plasma to the inner wall.

20. The method according to claim 19, wherein the inner wall of the chamber is a ground electrode electrically isolated from a remaining portion of the chamber.

21. A method of monitoring deposition of reaction products on an inner wall of a chamber, comprising:

generating a plasma by supplying first electromagnetic waves with a first electric power to a gas atmosphere within the chamber, the chamber including an inner wall;

depositing reaction products on the inner wall of the chamber; and

22. The method according to claim 21, wherein the inner wall of the chamber is a ground electrode electrically isolated from a remaining portion of the chamber.

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Case	Age	Sex	Site	Pathologic Findings	Survival
1	67	M	Rectum	Adenocarcinoma	10 mo
2	67	M	Rectum	Adenocarcinoma	10 mo
3	67	M	Rectum	Adenocarcinoma	10 mo
4	67	M	Rectum	Adenocarcinoma	10 mo
5	67	M	Rectum	Adenocarcinoma	10 mo
6	67	M	Rectum	Adenocarcinoma	10 mo
7	67	M	Rectum	Adenocarcinoma	10 mo
8	67	M	Rectum	Adenocarcinoma	10 mo
9	67	M	Rectum	Adenocarcinoma	10 mo
10	67	M	Rectum	Adenocarcinoma	10 mo
11	67	M	Rectum	Adenocarcinoma	10 mo
12	67	M	Rectum	Adenocarcinoma	10 mo
13	67	M	Rectum	Adenocarcinoma	10 mo
14	67	M	Rectum	Adenocarcinoma	10 mo
15	67	M	Rectum	Adenocarcinoma	10 mo
16	67	M	Rectum	Adenocarcinoma	10 mo
17	67	M	Rectum	Adenocarcinoma	10 mo
18	67	M	Rectum	Adenocarcinoma	10 mo
19	67	M	Rectum	Adenocarcinoma	10 mo
20	67	M	Rectum	Adenocarcinoma	10 mo
21	67	M	Rectum	Adenocarcinoma	10 mo
22	67	M	Rectum	Adenocarcinoma	10 mo
23	67	M	Rectum	Adenocarcinoma	10 mo
24	67	M	Rectum	Adenocarcinoma	10 mo
25	67	M	Rectum	Adenocarcinoma	10 mo
26	67	M	Rectum	Adenocarcinoma	10 mo
27	67	M	Rectum	Adenocarcinoma	10 mo
28	67	M	Rectum	Adenocarcinoma	10 mo
29	67	M	Rectum	Adenocarcinoma	10 mo
30	67	M	Rectum	Adenocarcinoma	10 mo
31	67	M	Rectum	Adenocarcinoma	10 mo
32	67	M	Rectum	Adenocarcinoma	10 mo
33	67	M	Rectum	Adenocarcinoma	10 mo
34	67	M	Rectum	Adenocarcinoma	10 mo
35	67	M	Rectum	Adenocarcinoma	10 mo
36	67	M	Rectum	Adenocarcinoma	10 mo
37	67	M	Rectum	Adenocarcinoma	10 mo
38	67	M	Rectum	Adenocarcinoma	10 mo
39	67	M	Rectum	Adenocarcinoma	10 mo
40	67	M	Rectum	Adenocarcinoma	10 mo
41	67	M	Rectum	Adenocarcinoma	10 mo
42	67	M	Rectum	Adenocarcinoma	10 mo
43	67	M	Rectum	Adenocarcinoma	10 mo
44	67	M	Rectum	Adenocarcinoma	10 mo
45	67	M	Rectum	Adenocarcinoma	10 mo
46	67	M	Rectum	Adenocarcinoma	10 mo
47	67	M	Rectum	Adenocarcinoma	10 mo
48	67	M	Rectum	Adenocarcinoma	10 mo
49	67	M	Rectum	Adenocarcinoma	10 mo
50	67	M	Rectum	Adenocarcinoma	10 mo
51	67	M	Rectum	Adenocarcinoma	10 mo
52	67	M	Rectum	Adenocarcinoma	10 mo
53	67	M	Rectum	Adenocarcinoma	10 mo
54	67	M	Rectum	Adenocarcinoma	10 mo
55	67	M	Rectum	Adenocarcinoma	10 mo
56	67	M	Rectum	Adenocarcinoma	10 mo
57	67	M	Rectum	Adenocarcinoma	10 mo
58	67	M	Rectum	Adenocarcinoma	10 mo
59	67	M	Rectum	Adenocarcinoma	10 mo
60	67	M	Rectum	Adenocarcinoma	10 mo
61	67	M	Rectum	Adenocarcinoma	10 mo
62	67	M	Rectum	Adenocarcinoma	10 mo
63	67	M	Rectum	Adenocarcinoma	10 mo
64	67	M	Rectum	Adenocarcinoma	10 mo
65	67	M	Rectum	Adenocarcinoma	10 mo
66	67	M	Rectum	Adenocarcinoma	10 mo
67	67	M	Rectum	Adenocarcinoma	10 mo
68	67	M	Rectum	Adenocarcinoma	10 mo
69	67	M	Rectum	Adenocarcinoma	10 mo
70	67	M	Rectum		